[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2012-0311; Special Conditions No. 25-458-SC]

Special Conditions: Boeing Model 787 Series Airplanes; Single-place Side-facing Seats with Inflatable Lapbelts

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions; request for comments.

SUMMARY: These special conditions are issued for the Boeing Model 787 series airplanes. These airplanes have a novel or unusual design feature associated with single-place side-facing seats with inflatable lapbelts. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: The effective date of these special conditions is March 12, 2012**.** We must receive your comments by **[insert a date 30 days after date of publication in the Federal Register].**

ADDRESSES: Send comments identified by docket number FAA-2012-0311 using any of the following methods:

- Federal eRegulations Portal: Go to http://www.regulations.gov/ and follow the online instructions for sending your comments electronically.

- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- Hand Delivery or Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, D.C., between 8 a.m. and 5 p.m., Monday through Friday, except federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to http://www.regulations.gov/, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at http://DocketsInfo.dot.gov/.

Docket: Background documents or comments received may be read at http://www.regulations.gov/ at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.

FOR FURTHER INFORMATION CONTACT: Jeff Gardlin, FAA, Airframe and Cabin Safety Branch, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601

Lind Avenue SW., Renton, Washington 98057-3356; telephone 425-227-2136; facsimile 425-227-1149.

SUPPLEMENTARY INFORMATION:

The FAA has determined that notice of, and opportunity for prior public comment on, these special conditions are impracticable because these procedures would significantly delay delivery of the affected aircraft. In addition, the substance of these special conditions has been subject to the public-comment process in several prior instances with no substantive comments received. The FAA therefore finds that good cause exists for making these special conditions effective upon issuance.

Comments Invited

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive by the closing date for comments. We may change these special conditions based on the comments we receive.

Background

On March 28, 2003, Boeing Commercial Airplanes applied for an FAA type certificate for its new Model 787 series airplane (hereafter referred to as "787"). The 787 is an all-new, twin-engine jet transport airplane with a two-aisle cabin which is currently approved under Type Certificate No. T000215E. The maximum takeoff weight is 476,000 pounds, with a maximum passenger count of 381. These airplanes have a novel or unusual design feature associated with single-place side-facing seats with inflatable lapbelts. The inflatable lapbelt is designed to limit

occupant forward excursion in the event of an accident. This will reduce the potential for head injury, thereby reducing the Head Injury Criteria (HIC) measurement. The inflatable lapbelt behaves similarly to an automotive airbag, but in this case the airbag is integrated into the lapbelt, and inflates away from the seated occupant. While airbags are now standard in the automotive industry, the use of an inflatable lapbelt is novel for commercial aviation.

Title 14, Code of Federal Regulations (14 CFR) 121.311(j) requires that no person may operate a transport category airplane type certificated after January 1, 1958, and manufactured on or after October 27, 2009, in passenger-carrying operations, after October 27, 2009, unless all passenger and flight attendant side-facing seats on an airplane operated under part 121 rules meet the requirements of 14 CFR 25.562 in effect on or after June 16, 1988.

Amendment 25-15 to part 25, dated October 24, 1967, introduced the subject of side-facing seats and a requirement that each occupant in a side-facing seat must be protected from head injury by a safety belt and a cushioned rest that will support the arms, shoulders, head, and spine.

Subsequently, Amendment 25-20 to part 25, dated April 23, 1969, clarified the definition of side-facing seats to require that each occupant of a seat that makes more than an 18 degree angle with the vertical plane containing the airplane centerline, must be protected from head injury by a safety belt and an energy absorbing rest that will support the arms, shoulders, head, and spine, or by a safety belt and shoulder harness that will prevent the head from contacting any injurious object. The FAA concluded that an 18-degree angle would provide an adequate level of safety based on tests that were performed at that time and thus adopted that standard.

Part 25 was amended June 16, 1988, by Amendment 25-64, to revise the emergency landing conditions that must be considered in the design of the airplane. Amendment 25-64 revised the static load conditions in § 25.561, and added a new § 25.562 that required dynamic testing for all seats approved for occupancy during takeoff and landing. The intent of Amendment 25-64 is to provide an improved level of safety for occupants on transport category airplanes. Because most seating is forward-facing on transport category airplanes, the pass/fail criteria developed in Amendment 25-64 focused primarily on these seats. As a result, the FAA issued Policy Memorandums ANM-03-115-30 and PS-ANM-100-2000-00123 to provide the additional guidance necessary to demonstrate the level of safety required by the regulations for side-facing seats.

The 787, operated under part 121, must meet all of the requirements of § 25.562 for passenger and flight attendant seats. Therefore it is in the interest of installers to show full compliance to § 25.562, so that an operator under part 121 may be able to use the aircraft without having to do additional certification work. It is also noted that some foreign civil airworthiness authorities have invoked these same operator requirements in the form of airworthiness directives.

Section 25.785 requires that occupants be protected from head injury by either the elimination of any injurious object within the striking radius of the head, or by padding. Traditionally, this has required a set back of 35 inches from any bulkhead or other rigid interior feature or, where not practical, specified types of padding. The relative effectiveness of these means of injury protection was not quantified. With the adoption of Amendment 25-64 to part

25, specifically § 25.562, a new standard that quantifies required head injury protection was created.

Section 25.562 specifies that each seat type design approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be shown to be compliant by rational analysis based on dynamic tests of a similar type seat. In particular, the regulations require that persons not suffer serious head injury under the conditions specified in the tests, and that protection must be provided or the seat be designed so that the head impact does not exceed a HIC of 1000 units. While the test conditions described for HIC are detailed and specific, it is the intent of the requirement that an adequate level of head injury protection be provided for passengers in a severe crash.

Because §§ 25.562 and 25.785 and associated guidance do not adequately address side-facing seats with inflatable lapbelts, the FAA recognizes that appropriate pass/fail criteria need to be developed that do fully address the safety concerns specific to occupants of these seats. These criteria were to be implemented via special conditions.

The inflatable lapbelt has two potential advantages over other means of head impact protection. First, it can provide significantly greater protection than would be expected with energy-absorbing pads, and second, it can provide essentially equivalent protection for occupants of all stature. These are significant advantages from a safety standpoint, since such devices will likely provide a level of safety that exceeds the minimum standards of the CFR. Conversely, inflatable lapbelts in general are active systems and must be relied upon to activate properly when needed, as opposed to an energy-absorbing pad or upper torso restraint that is passive, and

always available. Therefore, the potential advantages must be balanced against this and other potential disadvantages in order to develop standards for this design feature.

The FAA has considered the installation of inflatable lapbelts to have two primary safety concerns: first, that they perform properly under foreseeable operating conditions, and second, that they do not perform in a manner or at such times as would constitute a hazard to the airplane or occupants. This latter point has the potential to be the more rigorous of the requirements, owing to the active nature of the system.

The inflatable lapbelt will rely on electronic sensors for signaling and a stored gas canister for inflation. These same devices could be susceptible to inadvertent activation, causing deployment in a potentially unsafe manner. The consequences of inadvertent deployment as well as failure to deploy must be considered in establishing the reliability of the system. Boeing must substantiate that the effects of an inadvertent deployment in flight either would not cause injuries to occupants or that such deployment(s) meet the requirement of § 25.1309(b). The effect of an inadvertent deployment on a passenger or crewmember that might be positioned close to the inflatable lapbelt should also be considered. The person could be either standing or sitting. A minimum reliability level will have to be established for this case, depending upon the consequences, even if the effect on the airplane is negligible.

The potential for an inadvertent deployment could be increased as a result of conditions in service. The installation must take into account wear and tear so that the likelihood of an inadvertent deployment is not increased to an unacceptable level. In this context, an appropriate inspection interval and self-test capability are considered necessary. Other outside influences are lightning and high intensity radiated fields (HIRF). Existing regulations regarding lightning,

§ 25.1316, and existing HIRF special condition for the 787 series airplanes, Special conditions No. 25-354A-SC, are applicable. Finally, the inflatable lapbelt installation should be protected from the effects of fire, so that an additional hazard is not created by, for example, a rupture of the pyrotechnic squib.

In order to be an effective safety system, the inflatable lapbelt must function properly and must not introduce any additional hazards to occupants as a result of its functioning. There are several areas where the inflatable lapbelt differs from traditional occupant protection systems, and requires special conditions to ensure adequate performance.

Because the inflatable lapbelt is essentially a single use device, there is the potential that it could deploy under crash conditions that are not sufficiently severe as to require head injury protection from the inflatable lapbelt. Since an actual crash is frequently composed of a series of impacts before the airplane comes to rest, this could render the inflatable lapbelt useless if a larger impact follows the initial impact. This situation does not exist with energy absorbing pads or upper torso restraints, which tend to provide continuous protection regardless of severity or number of impacts in a crash event. Therefore, the inflatable lapbelt installation should provide protection when it is required, by not expending its protection during a less severe impact. Also, it is possible to have several large impact events during the course of a crash, but there is no requirement for the inflatable lapbelt to provide protection for multiple impacts.

Since each occupant's restraint system provides protection for that occupant only, the installation must address seats that are unoccupied. It will be necessary to show that the required protection is provided for each occupant regardless of the number of occupied seats, and considering that unoccupied seats may have lapbelts that are active.

The inflatable lapbelt should be effective for a wide range of occupants. The FAA has historically considered the range from the fifth percentile female to the ninety-fifth percentile male as the range of occupants that must be taken into account. In this case, the FAA is proposing consideration of a broader range of occupants, due to the nature of the lapbelt installation and its close proximity to the occupant. In a similar vein, these persons could have assumed the brace position, for those accidents where an impact is anticipated. Test data indicate that occupants in the brace position do not require supplemental protection, and so it would not be necessary to show that the inflatable lapbelt will enhance the brace position. However, the inflatable lapbelt must not introduce a hazard in that case when deploying into the seated, braced occupant.

Another area of concern is the use of seats, so equipped, by children whether lap-held, in approved child safety seats, or occupying the seat directly. Although specifically prohibited by the FAA operating regulations, the use of the supplementary loop belt ("belly belt") may be required by other civil aviation authorities, and should also be considered with the end goal of meeting those regulations. Similarly, if the seat is occupied by a pregnant woman, the installation needs to address such usage, either by demonstrating that it will function properly, or by adding appropriate limitation on usage.

Since the inflatable lapbelt will be electrically powered, there is the possibility that the system could fail due to a separation in the fuselage. Since this system is intended as crash/post-crash protection means, failure to deploy due to fuselage separation is not acceptable. As with emergency lighting, the system should function properly if such a separation occurs at any point in the fuselage.

Since the inflatable lapbelt is likely to have a large volume displacement, the inflated bag could potentially impede egress of passengers. Since the bag deflates to absorb energy, it is likely that an inflatable lapbelt would be deflated at the time that persons would be trying to leave their seats. Nonetheless, it is considered appropriate to specify a time interval after which the inflatable lapbelt may not impede rapid egress. Ten seconds has been chosen as a reasonable time since this corresponds to the maximum time allowed for an exit to be openable (§ 25.809). In actuality, it is unlikely that an exit would be prepared by a flight attendant this quickly in an accident severe enough to warrant deployment of the inflatable lapbelt, and the inflatable lapbelt is expected to deflate much quicker than ten seconds.

In addition, during the development of the inflatable lapbelt, the manufacturer was unable to develop a fabric that would meet the inflation requirements for the bag and the flammability requirements of Part I(a)(1)(ii) of appendix F to part 25. The fabrics that were developed that meet the flammability requirement did not produce acceptable deployment characteristics. However, the manufacturer was able to develop a fabric that meets the less stringent flammability requirements of Part I(a)(1)(iv) of appendix F to part 25 and has acceptable deployment characteristics.

Part I of appendix F to part 25 specifies the flammability requirements for interior materials and components. There is no reference to inflatable restraint systems in appendix F, because such devices did not exist at the time the flammability requirements were written. The existing requirements are based on both material types, as well as use, and have been specified in light of the state-of-the-art of materials available to perform a given function. In the absence of a specific reference, the default requirement would be for the type of material used to construct the

inflatable restraint, which is a fabric in this case. However, in writing special conditions, the FAA must also consider the use of the material, and whether the default requirement is appropriate. In this case, the specialized function of the inflatable restraint means that highly specialized materials are needed. The standard normally applied to fabrics is a 12-second vertical ignition test. However, materials that meet this standard do not perform adequately as inflatable restraints. Since the safety benefit of the inflatable restraint is very significant, the flammability standard appropriate for these devices should not screen out suitable materials, thereby effectively eliminating use of inflatable restraints. The FAA will need to establish a balance between the safety benefit of the inflatable restraint and its flammability performance. At this time, the 2.5-inch per minute horizontal test is considered to provide that balance. As the state-of-the-art in materials progresses (which is expected), the FAA may change this standard in subsequent special conditions to account for improved materials.

Finally, it should be noted that the special conditions are applicable to single-place side-facing seats with an inflatable lapbelt system installed. The special conditions are not an installation approval. Therefore, while the special conditions relate to each such system installed, the overall installation approval is a separate finding, and must consider the combined effects of all such systems installed.

Type Certification Basis

Under the provisions of 14 CFR 21.17, Boeing Commercial Airplanes, must show that the 787 series airplanes meet the applicable provisions of part 25, as amended by Amendments 25-1 through 25-120, 25.125, 25-125, and 25-128 with the following exception: § 25.1309 remains at Amendment 25-119 for cargo fire protection systems.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the 787 series airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, the special conditions would also apply to the other model.

In addition to the applicable airworthiness regulations and special conditions, the 787 series airplanes must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36; and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the "Noise Control Act of 1972.".

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

Novel or Unusual Design Features

The 787 series airplanes incorporate the following novel or unusual design features: Boeing Commercial Airplanes is installing single-place side-facing seats with inflatable lapbelts on certain seats of 787 series airplanes, in order to reduce the potential for head and neck injury in the event of an accident. The inflatable lapbelt works similar to an automotive airbag, except that the airbag is integrated with the lapbelt of the restraint system.

The CFR states the performance criteria for head injury protection in objective terms. However, none of these criteria are adequate to address the specific issues raised concerning single-place side-facing seats with inflatable lapbelts. The FAA has therefore determined that, in addition to the requirements of part 25, special conditions are needed to address requirements particular to installation of single-place side-facing seats with inflatable lapbelts.

Accordingly, in addition to the passenger injury criteria specified in § 25.785, these special conditions are adopted for the 787 series airplanes equipped with single-place side-facing seats with inflatable lapbelts. Other conditions may be developed, as needed, based on further FAA review and discussions with the manufacturer and civil aviation authorities.

Discussion

From the standpoint of a passenger safety system, the inflatable lapbelt is unique in that it is both an active and entirely autonomous device. While the automotive industry has good experience with airbags, the conditions of use and reliance on the inflatable lapbelt as the sole means of injury protection are quite different. In automobile installations, the airbag is a supplemental system and works in conjunction with an upper torso restraint. In addition, the crash event is more definable and of typically shorter duration, which can simplify the activation logic. The airplane operating environment is also quite different from automobiles and includes the potential for greater wear and tear, and unanticipated abuse conditions (due to galley loading, passenger baggage, etc.); airplanes also operate where exposure to high intensity electromagnetic fields could affect the activation system.

The following special conditions can be characterized as addressing either the safety performance of the system, or the system's integrity against inadvertent activation. Because a

crash requiring use of the inflatable lapbelts is a relatively rare event, and because the consequences of an inadvertent activation are potentially quite severe, these latter requirements are probably the more rigorous from a design standpoint.

Applicability

As discussed above, these special conditions are applicable to the 787 series airplane. Should Boeing Commercial Airplanes apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

Conclusion

This action affects only certain novel or unusual design features on 787 series of airplanes. It is not a rule of general applicability.

The substance of these special conditions has been subjected to the notice and comment period in several prior instances and has been derived without substantive change from those previously issued. It is unlikely that prior public comment would result in a significant change from the substance contained herein. Therefore, because a delay would significantly affect the certification of the airplane, which is imminent, the FAA has determined that prior public notice and comment are unnecessary and impracticable, and good cause exists for adopting these special conditions upon issuance. The FAA is requesting comments to allow interested persons to submit views that may not have been submitted in response to the prior opportunities for comment described above.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Boeing Model 787 series airplanes**.**

1. Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupant of a side facing seat. Head Injury Criterion (HIC) assessments are only required for head contact with the seat and/or adjacent structures.

2. Body-to-Wall/Furnishing Contact: Under the load condition defined in § 25.562 (b)(2), the seat must be installed aft of a structure such as an interior wall or furnishing that will support the pelvis, upper arm, chest, and head of an occupant seated next to the structure. A conservative representation of the structure and its stiffness must be included in the tests.

3. Thoracic Trauma: Under the load condition defined in § 25.562(b)(2), Thoracic Trauma Index (TTI) injury criterion must be substantiated by dynamic test or by rational analysis based on previous test(s) of a similar seat installation. Testing must be conducted with a Side Impact Dummy (SID), as defined by Title 49 Code of Federal Regulations (CFR) part 572, subpart F, or its equivalent. TTI must be less than 85, as defined in 49 CFR part 572, subpart F. The SID TTI data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) § 571.214, section S6.13.5.

4. Pelvis: Under the load condition defined in § 25.562(b)(2), pelvic lateral acceleration must be shown by dynamic test or by rational analysis based on previous test(s) of a similar seat

installation to not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS § 571.214, section S6.13.5.

5. Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

6. Neck Injury Criteria: The seating system must protect the occupant from experiencing serious neck injury.

General Test Guidelines

1. One longitudinal test with the SID Anthropomorphic Test Dummy (ATD), undeformed floor, no yaw, and with all lateral structural supports (armrests/walls).

2. Pass/fail injury assessments: TTI and pelvic acceleration. One longitudinal test with the Hybrid II ATD, deformed floor, with 10 degrees yaw, and with all lateral structural supports (armrests/walls). Pass/fail injury assessments: HIC, and upper torso restraint load, restraint system retention and pelvic acceleration.

3. Vertical (14 G's) test is to be conducted with modified Hybrid II ATDs with existing pass/fail criteria.

> Note: It must be demonstrated that the installation of seats via plinths or pallets meets all applicable requirements. Compliance with the guidance contained in FAA Policy Memorandum PS-ANM-100-2000-00123, dated February 2, 2000, titled "Guidance for Demonstrating Compliance with Seat Dynamic Testing for Plinths and Pallets" will be acceptable to the FAA.

Inflatable Lapbelt Conditions

If inflatable lapbelts are installed on single-place side-facing seats, the inflatable lapbelt(s) must meet the final inflatable lapbelt special conditions (Special Conditions No. 25-431-SC (76 FR 35324, June 17, 2011).

Issued in Renton, Washington, on March 12, 2012.

John Piccola
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service, ANM-100

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